

Condition Monitoring of wind turbines based on vibration analysis

"If you can hear it, we can measure it."

Easy TurbineAnalyzer is a new measuring and analysis technique developed by the Danish company Ortosense in collaboration with Beckhoff. This innovative technology enables reliable and efficient monitoring of wind turbines. The system, which is based on vibration analysis, provides high-precision measurement results and enables early detection of wear and faults on wind turbines. This means that expensive repairs and prolonged downtime can be avoided, significantly reducing the repair and maintenance costs over the life cycle of a wind turbine.

Experienced engineers have always been able to hear the trademark sounds when something is wrong with a machine. The aim of the Danish company Ortosense, based in Birkerød, was to develop devices that can not only monitor and analyze frequencies, but also vibrations.

An ear at the machine: the Ortosense analysis method

The algorithm behind the technology developed by Ortosense comes pretty close to an exact vibration analysis similar to the one performed by the human ear: "By comparing oscillation frequencies one can achieve much higher accuracy than with pure frequency analysis since signals can be separated from each other. This enables much earlier detection of changes in the sound spectrum," said Carsten Ottosen, CEO of Ortosense.

The new monitoring system is based on an algorithm which, put simply, processes the data obtained in a non-destructive manner with a measuring system and analyzes the wind turbine conditions. If the measured signals indicate a problem, the system sends a warning message via SMS or an alarm if a specified limit is exceeded.

In the past traditional frequency analyses such as Fast Fourier transformations (FFT) were used in order to detect changes or damage, for example, in the gear unit of a wind turbine. FFT has the disadvantage that the result is

strongly influenced by the speed, among other factors, so that it is difficult to detect damped resonance frequencies in the spectrum. This particularly applies to periodic signals, which are present in rotating machines. In addition, the energy of an impulse of a dampened resonance frequency is distributed over the whole spectrum, which means that the amplitude of the resonance frequencies is smaller.

Ortosense therefore developed an oscillation and vibration analysis technique that is insensitive to changes in speed and is therefore able to determine resonance frequencies with much higher accuracy than other frequency analysis methods. The Ortosense technology referred to as Auditory Perceptual Pulse Analysis (APPA) is based on interference analysis and has left the problems associated with FFT behind. It perfectly mimics the sound perception ability of the human ear and enables reliable monitoring of wind turbines.

The standard version of Easy TurbineAnalyzer comprises three different measuring points. The recorded data are processed and analyzed with TwinCAT PLC software from Beckhoff and subsequently compared with carefully selected reference data. As soon as a deviation from the reference data is detected, the TurbineAnalyzer automatically sends a warning message to the operator via SMS. The collected data can be copied from the analyzer to a standard USB flash drive on a regular basis.



Easy TurbineAnalyzer is a plug-and-play solution for Condition Monitoring in wind turbines.

The Easy TurbineAnalyzer is exceptionally compact. It takes up no more space than a pound-pack of coffee and can therefore be installed easily in a wind turbine. The standard version of Easy TurbineAnalyzers can be upgraded in stages, for example with up to six measuring points in addition to the power generation unit, an Ethernet port for sending data to external units, and a data analysis program developed by Ortosense.

Robust measurement technology, integrated in the Beckhoff control platform

"The first step involved development of the measurement technology and of the software for efficient data recording and analysis," said Carsten Ottosen. The second step involved finding a suitable control platform. This is when Ortosense decided to work with Beckhoff as an automation partner. The compact controller consists of a DIN rail-mountable CX9001 Embedded PC with two directly attached EL3632 EtherCAT Condition Monitoring terminals. "The modularity and openness of the PC-based control technology precisely meets our requirements," said the Managing Director of Ortosense.

The new portable measuring devices can now be used to record Condition Monitoring data on wind turbines: "In practice, three accelerometers are attached to different measuring points with strong magnets, e.g. at the planetary gear, the rotor shaft and the generator shaft. In addition, the

generated current can be measured by applying a terminal around the main cable. All the hardware can be installed in less than an hour," said Carsten Ottosen.

Cost reductions through intelligent Condition Monitoring

"If you can hear it, we can measure it," is the motto of Ortosense. This is how the company describes the extensive application options of its measuring and analysis techniques in a wide range of industrial sectors and applications. Carsten Ottosen said: "Our measuring systems can be used wherever there are mechanical parts or motors that are subject to wear, and where an outage or shutdown would have significant economic consequences. In addition we can help reduce costs and improve the efficiency of renewable energy applications."

Further Information:

www.ortosense.com

www.beckhoff.dk